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THE IMPORTANCE OF THE TARNISHED PLANT BUG IN THE DISSEMINATION OF FIRE BLIGHT IN NURSERY STOCK

V. B. Stewart

With Plate XXIII

For the past five summers considerable attention has been given to the dissemination of fire blight bacteria or *Bacillus amylivorus* (Burr.) Trev. in nursery stock, by various insects, and the results of some observations made have been incorporated into a previous publication by the writer.[1] Therein it is stated: "It has been definitely proved that aphids (*Aphis pomi* De Geer) spread the disease and observations during the past two seasons indicate that several other sucking insects may disseminate the blight bacteria in the nursery. On July 1, 1912, the following species of sucking bugs were collected from apple nursery stock by Prof. C. R. Crosby of the Department of Entomology, Cornell University: *Reduviolus ferus* Linn., *Plagiognathus politus* Uhler, *Platymetopius acutus* Say., *Empoasca mali* Le Baron, *Typhlocyba rosae* Linn., *Campylomma verbasci* Meyers, and *Lygus pratensis* Linn." During the past summer, Mr. M. D. Leonard of the Department of Entomology, Cornell University, collected the following species which should be added to the list: *Orthotylus flavosparsus* Sahlb., *Chlamydatus associatus* (Uhl.) Reut., *Cosmopepla carnifex* Fab. and *Siphocoryne avenae* Fab.

Among these insects the tarnished plant bug (*Lygus pratensis* Linn.) has appeared to be the most important in transmitting the blight parasite to healthy trees, and usually it has been the most common insect observed on the stock susceptible to the disease. During the month of July the tarnished plant bugs are most abundant on the apples and as a rule the blight has become more prevalent in the apples with their appearance. This has been especially true for the past three seasons. As determined by the experiments subsequently discussed, these insects disseminate the blight in the following manner:

[1] Stewart, V. B. The fire blight disease in nursery stock. New York (Cornell) Agr. Exp. Sta. Bul. 329: 317–371. 1913.

Visiting blighted tissues the insects become smeared with the gummy exudate from the blight lesions and carry bacteria to the tender twigs. Here in sucking the sap the insects puncture the tissues, thus forming a means of entrance for the blight germs with the result that the twigs may soon become infected.

A number of seedling apples used for grafting purposes were planted in the month of April and from each of these several tender shoots developed which afforded excellent material for the following experiments:

EXPERIMENT I

On June 19, 1913, several tarnished plant bugs, obtained by sweeping wild mustard plants with a net, were smeared by means of a camel's hair brush with a seven-days-old agar culture of *Bacillus amylivorus* and placed on the shoots of three different trees. By means of the camel's hair brush, the six shoots of two other trees were smeared with the agar culture of the causal organism and several tarnished plant bugs placed on the smeared shoots. The four shoots of two other seedlings were smeared with the agar culture but the bugs were excluded. Also the tarnished plant bugs were placed on the five shoots of two other trees which had not been smeared with the blight bacteria.

All trees were covered with wire screen cages, with an outside covering of white cheesecloth. The cages were about four inches in diameter and fourteen inches high. Care was taken not to injure the shoots when the cages were being placed over them.

On June 25 the cages were removed and about 70 per cent of the shoots were badly blighted on the trees where both the blight bacteria and the bugs were present.

All the shoots on the check trees remained healthy except that a slight injury, like that caused by the tarnished plant bugs, was apparent on the trees where the bugs were caged but the blight organism excluded. The shoots smeared with the agar culture failed to blight when the tarnished plant bugs were not present.

EXPERIMENT II

On June 27 some of the blighted shoots of the previous experiment showed the characteristic gummy exudation. Tarnished plant bugs, obtained again from sweeping wild mustard, were placed on the diseased shoots and the trees covered with the wire screen cages as before. Two blighted trees were covered in this manner. The bugs, ten in each cage, were allowed to run over the exuded shoots for a period of five hours. They were then transferred to the shoots of two healthy trees and covered with the cages.

At the same time three shoots of a healthy tree were smeared with a pure agar culture of the causal organism and several bugs caged over the trees for five hours, then transferred to another tree free from blight.

Ten bugs were enclosed in a cage over a tree with three tender shoots.

All the cages were removed on July 3, and a large percentage of the bugs were still alive. In one cage all of the shoots (three in number) were badly blighted where the bugs were transferred from the trees with the gummy exudation; in the other cage containing bugs from trees bearing the exuding lesions, two of the four shoots were diseased.

Two of the three shoots were affected where the bugs had been transferred from the trees smeared wlth the agar culture. The tarnished plant bugs taken directly from the wild mustard plants and placed on the check tree produced the characteristic injury of the tarnished plant bug but none of the shoots blighted.

From the experiments conducted it is evident that the tarnished plant bugs are able to transmit the causal organism of fire blight from exuding blight lesions to healthy shoots. Their importance in the actual dissemination of the blight bacteria is more strongly emphasized by conditions which existed during the past season.

On May 14, 1913, about thirty blighted two-years-old Kieffer pear trees were found in a large block of pears in the nursery row. The infections had occurred at the tips of the young tender shoots and in several trees the blight had involved a portion of the trunks. The diseased trees were confined to definite areas and from all appearances the blight had been spread by insects.

Judging from weather conditions the infections had ocurred about two weeks earlier during a period of warm weather which was favorable both to the growth of the new shoots and also for the appearance of the numerous sucking bugs found on nursery stock. The infections at the time of discovery were all considerably advanced, but there had been no spread of the disease for some time because of the recent cold weather which had a tendency not only to check the activities of the sucking insects but also to retard the blight organism.

About May 1, the Kieffer pears, which are an early growing variety, were practically the only pear trees that had made any growth, and at this time Professor Crosby reported the presence of a large number of tarnished plant bugs feeding on the new, tender shoots. Evidently some of these bugs had visited a hold-over canker which was subsequently found on a tree in that vicinity. The bacteria in the hold-over canker had again become active with the ascent of sap in the spring, causing an exudation which furnished a source for new infections when visited by the bugs.

The other varieties of pears were not attacked because very little new

growth had been made at this time. Only two infections were found in the Clapp Favorite; the remainder were found in the Kieffer variety. The diseased trees were removed and all sources of infection eradicated. Although the bugs were present in abundance on these trees for some time to follow, practically no more blight occurred in the pear block for the remainder of the summer. It is believed that a severe blight epidemic was averted by this prompt eradication of sources of infection.

The conditions as discussed above emphasize the necessity of removing all blight infections as soon as they appear. Without the sources of infection, the presence of the various disseminating agents is not so important.

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EXPLANATION OF PLATE XXIII

The bug is shown natural size and enlarged. From a photograph by Prof. M. V. Slingerland. The shoots on the blighted tree, at the right, were inoculated by bugs transferred from twigs exuding blight bacteria. The other tree, at the left, was infested with bugs collected from wild mustard. It did not blight. Trees nearly natural size.

PLATE XXIII. THE TARNISHED PLANT BUG AND ITS WORK

BLACK PIT OF LEMON[1]

CLAYTON O. SMITH

WITH PLATE XXIV

This blemish has been appearing occasionally for the past three years on the two chief commercial varieties of lemons, the Eureka and Lisbon, being somewhat more abundant on the latter. The trouble has gradually increased, and is now assuming some economic importance, occurring to a limited extent in all the lemon growing sections of southern California. It develops in the grove on tree-ripe lemons during the spring months, and does not reappear during the remainder of the year.

The spots or pits confine themselves entirely to the rind, are circular or oval in outline, 5 to 20 mm. in diameter, firm (not a soft rot), reddish-brown (isabellinus) to brown (castaneus[2]) or black. The tissue is depressed somewhat below the bottom of the normal oil glands into the white portion of the rind. In the center of the pit is usually to be found a thorn stab or other injury where the infection has taken place. The line between the healthy and diseased tissue is distinct and sharply defined. Professor Rolfs' illustration of the withertip fruit spot in his bulletin Wither-Tip and Other Diseases of Citrus, etc. would also serve as a good illustration of the black pit disease.[3]

These pits, when first observed, were at once associated with Professor Rolfs' illustration and cultures were made to isolate the supposed fungus, but these gave negative results. When the trouble again appeared, some of the affected tissue was inoculated into healthy lemons that were left on the tree. These inoculations gave a considerable number of typical infections which showed very conclusively that some active organism was present. Other cultures were now made in tubes of dilute prune juice and in petri dishes of nutrient agar. After a week's time thirteen tubes of prune juice showed no growth, while in three Penicillium had developed. In the agar dilution cultures, several suspicious white colonies appeared and were transferred to agar slant tubes. From these transfers artificial inoculations were made on lemons growing in the open. Successful results

[1] Paper No. 1, Citrus Experiment Station, College of Agriculture, University of California, Riverside, California.

[2] Saccardo, P. A. Chromotaxia seu nomenclator colorum.

[3] U. S. Dept. Agric., Bur. Pl. Ind., Bul. 52, plate 3, fig. 1.

appeared in about five days. The organism can readily be isolated from diseased tissue and has been repeatedly reisolated from artificially produced pits.

In these preliminary studies the diseased fruits were also kept in a moist chamber to favor the development of any organism that might be present and the following observations were made after the diseased lemons had remained for some time in a moist chamber. (1) A bacterial exudation often appeared at the points where the tissue had been pierced by some natural agent, possibly a thorn. (2) Sometimes pits were observed to enlarge slightly, and in one instance two coalesced. (3) Cuts made through the diseased tissue often showed an exudation at the vascular bundles of the diseased rind. An examination of this substance under a microscope showed it to consist of bacteria. (4) What appeared to be small pustules on the surface of the pit occurred. These gave every indication of the initial formation of acervuli, but spores never developed. An examination of these and the tissue showed the presence of bacteria. (5) Clouded drops of liquid containing many bacteria often accumulated on the surface of the diseased pits produced by artificial puncture inoculations.

Artificial inoculations have been made (1) by puncturing fruit with a sterile needle and transferring the organism from a pure culture, (2) by using a hypodermic syringe, (3) by atomizing the fruit in moist chambers.

The first two methods have been employed both on fruit in moist chamber and that still attached to the tree and subject to normal climatic conditions. Successful inoculations have, almost without exception, resulted from puncture inoculation in three to ten days. Some successful ones were also secured from atomizing, but here only a very few pits developed, and then only on about one-half of the fruits sprayed. The following citrus fruits have been successfully inoculated by punctures: Eureka lemon, Valencia orange, navel orange, grape fruit and sour limes. These results are summarized in the following table.

Definite spots begin to develop in three to five days from inoculation. The beginning of the pit first shows in the tissue immediately surrounding the puncture as a slight darkening of the oil glands, soon followed by that of the intermediate tissue. The tissue beneath the surface of the pit becomes discolored with a distinct dark line between the diseased and healthy tissue. This diseased condition extends through the rind to the pulp. The spots after reaching a certain size, 5 to 20 mm., do not increase further, except in rare instances, but become depressed, smooth, firm, and of a brownish (castaneus) or black color. At the outer margin of the pits sometimes a reddish brown zone develops. The black pit of lemon somewhat closely resembles spots found in nature on citrus fruits other than lemon, but its identity with these blemishes has not yet been demonstrated.

Artificial inoculation on lemons

HOW INOCULATED	LEMONS	DATE	ENVIRONMENT	RESULT	DATE
Diseased tissue	4 tree ripes	3/30/11	On tree	Positive	4/11/11
	3 tree ripes	4/11/12	On tree	Positive	4/23/12
Puncture culture	2 tree ripes	5/26/12	On tree	Positive	5/31/12
	3 green	5/31/12	On tree	Positive	6/10/12
	3 tree ripes	6/1/12	On tree	Positive	6/10/12
Hypodermic	1 tree ripe	6/3/12	On tree	Positive	6/10/12
	3 green	6/3/12	On tree	Positive	6/10/12
Check puncture	2 tree ripes	6/5/12	On tree	Negative	6/13/12
Puncture culture	3 tree ripes	9/28/12	On tree	Positive	10/8/12
Hypodermic	3 tree ripes	6/6/12	Moist chamber	Positive	6/25/12
Atomizing	14 tree ripes	6/6/12	Moist chamber	8 Positive	6/13/12
Puncture culture	5 tree ripes	6/6/12	Moist chamber	Positive	6/17/12
	3 tree ripes	9/28/12	Moist chamber	Positive	10/28/12
	3 green	10/24/12	Moist chamber	Positive	10/30/12
	3 green	10/31/12	Moist chamber	Positive	11/10/12
	3 tree ripes	12/6/12	Moist chamber	Positive	1/10/13
	4 tree ripes	12/11/12	Moist chamber	Positive	1/11/13

Artificial inoculations on other citrous fruits

HOW INOCULATED	FRUIT	DATE	ENVIRONMENT	RESULT	DATE
Puncture culture	3 yellow limes	6/24/12	Moist chamber	Positive	6/27/12
	3 yellow limes	6/26/12	Moist chamber	Positive	7/1/12
Hypodermic	3 yellow limes	6/26/12	Moist chamber	Positive	7/1/12
Atomizing	7 tree ripe limes	6/26/12	Moist chamber	Doubtful	7/17/12
Puncture culture	1 grape fruit	7/1/12	On tree	Positive	7/18/12
Hypodermic	3 grape fruit	7/1/12	On tree	Positive	7/18/12
Puncture culture	1 Valencia orange	6/1/12	On tree	Positive	6/10/12
	3 navel oranges	11/6/12	Moist chamber	Positive	11/12/12
Atomized	3 navel oranges.	11/6/12	Moist chamber	Negative	12/6/12
Puncture culture	4 Valencia oranges	11/11/12	Moist chamber	Positive	11/20/12

The black pit organism in young agar cultures is actively motile by a single polar flagellum (Pitfield's stain). It measures 1 micron or less in shorter diameter and is two or three times as long as broad. It is usually single, may be found in pairs, but has only very rarely been observed to occur in chains. No spores or capsules have been demonstrated.

On slant tubes of standard nutrient agar the growth is pearl gray, thin and spreading. In standard nutrient agar dilution cultures the surface colonies appear in two to three days at 26 to 29°C. They are grayish-white, circular, 2 to 2.5 mm. in diameter, with rather indistinct entire margins, the whole structure of the colony being composed of very fine granules as seen with a low power of a compound microscope. The deeper colonies appear bi-convex in shape.

On standard 10 per cent gelatin a stratiform type of liquefaction occurs rather slowly, and a white precipitate is deposited on the unliquefied surface before liquefaction is completed. Bouillon is clouded rather densely, producing a ring-like formation on the sides of tube at the surface of the media. In some of the sugar bouillons a definite pellicle is formed at the surface. The organism is aerobic, no gas forming during thirty days in all the sugars tried: dextrose, lactose, galactose, saccharose, maltose, glycerine and mannite.

On potato cylinders the growth is at first white, but changes to a pearl-gray color; a grayish staining of the cylinders also occurred, while check tubes retained their white color.

Indol was shown to be formed in ten days in Dunham solution, incubated at 26 to 29°C.

On sterilized orange and lemon rind there is a characteristic growth that differs from the pearl-gray color that is produced in other media. At first this appears to be straw color (stramineous),[4] but in two weeks has changed to a putty color, and in one month has become dark fawn.[5] The rind has also darkened, becoming at the end of thirty days a chestnut-brown. In artificial puncture inoculations on lemons in a moist chamber piled-up putty colored[6] drops of bacterial growth often accumulate at the surface where the original punctures were made. On 3 per cent glucose lemon agar (a decoction of lemon rind), and on this same agar diluted with an equal part of standard nutrient agar, the same colored bacterial growth is formed as on lemon and orange rind. Transfers of this colored growth back to standard nutrient agar develop the pearl-gray color again.

In milk and litmus milk the tubes at first show no change, but gradually become intensely alkaline and clear without the separation of the casein.

Bacterium citriputeale nov. sp.

Latin diagnosis.[7] Baculis cylindricis apicibus rotundatis, solitariis aut geminatis, 2–4 x 0.5–1μ, mobilibus, aerobiis, neque capsulas neque sporas

[4] Saccardo. Loc. cit.

[5] Danthenay, Henri. Repetoire de couleurs, pp. 311, 307.

[6] Danthenay. Loc. cit., p. 311.

[7] Translated through the kindness of Prof. W. A. Setchell.

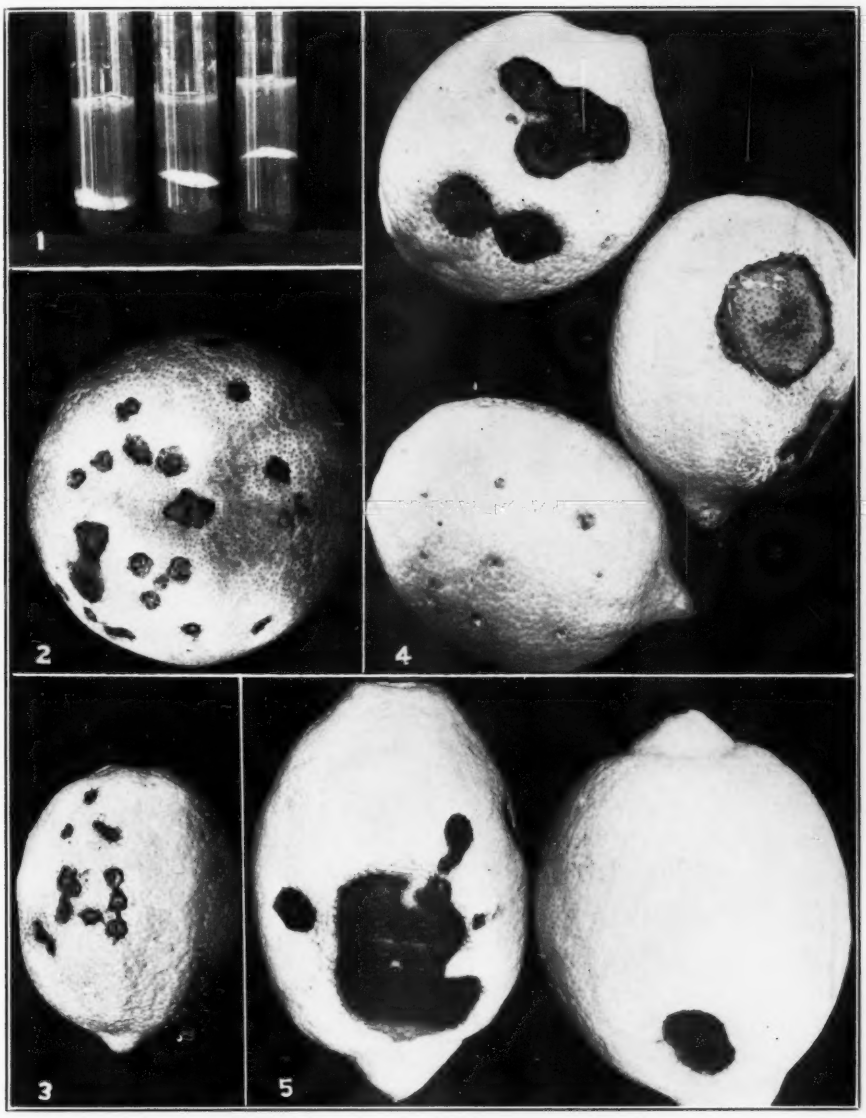

PLATE XXIV. BLACK PIT OF LEMON

FIG. 1. Gelatin tubes showing partial liquefaction and white deposit on unliquefied portion.

FIG. 2. Navel orange inoculated with pure culture by puncture, and kept in a moist chamber for six days.

FIG. 3. Puncture inoculations with steel needle, of lemon on tree, ten days time.

FIG. 4. Two tree-ripe lemons inoculated on tree by hypodermic injection, seven days development; one lemon as check.

FIG. 5. Black pit as found on lemon trees, natural infection.

formantibus, in medio saccharino aerem non producentibus, putea depressa, discolorata, 5–20 mm. diam. in cortice fructus Citri Limoni in ditione Californiensi incolentibus. Coloniis superficialibus in agar-agar margaritaceo-griseis, orbicularibus, 2–5 mm. diam. post dies 3 apud 26°–29°C. incubatis, levibus, nitentibus, marginibus integris; in cylindricis Solani tuberosi cultis, margaritaceo-griseis cum evidenter discolore et cum colore griseo augmento; in lacte sterili cultis primo non mutantis sed aetate provectiore alkalinis lucidisque sine "casein" segregatione: in solutionem "Dunham" dictam in dies 10 "indol" formantibus; in gelatinam cultis liquationem stratiformen inducentibus; in cortice fructus Citri Limoni inoculatis, putea profunda typica 3–15 mm. diam in dies 3–10 facientibus.

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PRODUCTION OF SECONDARY SPORIDIA BY GYMNOSPORANGIUM[1]

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With One Figure in the Text

In the spring of 1913, while conducting investigations on the cedar rust fungus, the writer observed the production of secondary spores by the germinating sporidia of *Gymnosporangium juniperi-virginianae* Schw. These spores have been designated "secondary" sporidia to distinguish them from the primary sporidia from which they originate.[2] The following observations upon the development of these spores have been made.

On March 28, 1913, some "cedar apples" were gathered and placed in a moist chamber. The following day highly gelatinous tentacles had been put forth and teleutospores in abundance were secured. Some of these teleutospores were placed in hanging drops of water and examined from

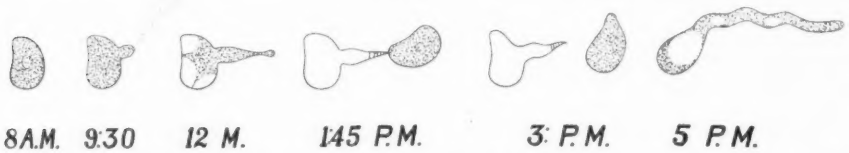

Fig. 1. Successive stages in the production of a secondary sporidium from a primary sporidium.

time to time. They germinated in the ordinary way with the production of four sporidia on the promycelium from each teleutospore cell.

On March 30 it was noticed that some of these sporidia had germinated and instead of producing vegetative hyphae had each produced on a short sterigma, a secondary spore identical in shape, color, and markings with the primary spore but slightly smaller in size.

This aroused suspicion and more hanging drops were prepared. The production of secondary sporidia was observed in all cases. On April 10 the following note and the accompanying drawings were made.

[1] Paper No. 27 from the laboratory of Plant Pathology, Virginia Agricultural Experiment Station. The writer is indebted to Dr. H. S. Reed for criticising this paper.

[2] Kunkel, Otto The production of a promycelium by the aecidiospores of Caeoma nitens Burrill. Bul. Torrey Bot. Club **40**: 361–366. fig. 1. 1913. Casual mention is here made of the production of secondary sporidia by Caeoma nitens.

Some Van Tieghem cells were prepared with distilled water and inoculated with sporidia from cedar apples made gelatinous in a moist chamber. One of these showing a good field was clamped under the microscope and watched all day. Each sporidium germinated as follows: A budlike process was put forth at some point on the sporidium wall. There seemed to be no definite place to put forth this bud. The bud elongated and the protoplasmic contents of the sporidium extended into it. After growing about 10–25 microns long the bud became pointed and tipped with a little globular body which swelled rapidly and became a secondary sporidium into which the contents of the primary sporidium flowed, leaving the latter empty and hyaline. The secondary sporidium thus produced remained attached to the old sporidium in one case only about an hour. Usually they stayed attached much longer. The process on which the secondary sporidium is borne is virtually a sterigma identical in appearance with those on which the sporidia of the promycelium are borne. The secondary sporidia then germinated producing vegetative hyphae into which the protoplasm flowed. Beyond this no growth took place and the spore and mycelium finally collapsed.

Observations were continued throughout the period of spore production by the cedar apples and almost invariably the production of secondary sporidia took place abundantly.

In two instances, however, April 16 and 19, a large percentage of the sporidia set for germination in hanging drops produced vegetative hyphae directly, without the intermediary production of secondary sporidia. The sporidia used for these two germination tests were secured from cedar apples which were drying after having become gelatinous in a moist chamber.

Much difficulty was encountered in preparing permanent slides properly stained with which to record the process of secondary sporidia production. The following method finally gave good results.

A quantity of teleutospores was placed in water in early morning and a mount was made every half hour during the day.

1. A few loops of the material were transferred to a cover glass and allowed to dry in the air.

2. As soon as dry it was covered with cold carbol-fuchsin for three to five minutes. The secret here is to get the stain on as soon as the material is dry.

3. The excess of stain was removed by carefully dipping the cover glass into water.

4. The cover glass and material were then allowed to dry in air.

5. As soon as dry the preparation was mounted in balsam on a slide.

By this method a good series of slides was obtained showing all stages in the production of secondary sporidia.

The production of secondary sporidia seems to be the rule, and direct germination or the production of a germ tube directly from the primary sporidium the exception. The question naturally arose, what are the conditions which determine whether the germination of primary sporidia is to be direct or indirect? As we noticed before, when teleutospores are placed in hanging drop they produce sporidia which in turn immediately produce secondary sporidia. This has been repeatedly observed. Again, if sporidia are produced on the cedar apple, allowed to dry, and then placed in hanging drop, a large percent of them produce germ tubes directly, while only a small number produce secondary sporidia. This was twice observed, April 16 and 19.

Later in the season when the warm rains began, it was noticed that when several consecutive days of rain occurred and the cedar apples were kept moist for a long time the teleutospores germinated with the production of sporidia which in turn produced secondary sporidia abundantly in situ. When, on the other hand, a shower was followed by sunshine or wind and the cedar apples dried up rapidly, primary sporidia were produced in abundance and shed as soon as dry. If these dry primary sporidia were collected and placed in water they germinated, some producing germ tubes directly and some producing secondary sporidia.

The indications are that, when kept continually moist from the time of production, the primary sporidia will produce secondary sporidia and that, when the primary sporidium becomes dry immediately following its production, and subsequently wet, it may germinate either directly or indirectly. The extent of the dryness may be the determining factor. Further investigations will be made.

Are the secondary sporidia able to survive a drying or resting period before germination? Are they produced when conditions for infection are not good and are they able to tide the fungus over until conditions are good? These questions remain unanswered.

It is barely possible that in case a primary sporidium germinates in an uncongenial environment, on the ground, for example, or on foliage which it cannot infect, that a secondary sporidium may be produced, which when dry might be transferred by the wind to an apple leaf and there in the presence of moisture cause infection. This, however, is mere speculation and no doubt will justify further investigation.

The production of secondary sporidia has also been observed by the writer in *Gymnosporangium clavipes*. This phenomenon may be common to other species of Gymnosporangium.

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A PRELIMINARY NOTE ON POLYPORUS DRYADEUS AS A ROOT PARASITE ON THE OAK[1]

W. H. Long

Bulliard in 1789 figured and described under the name of *Boletus pseudo-igniarius* a fungus which most European mycologists believe is the plant now called *Polyporus dryadeus*. In 1796 Persoon described it under the name of *Boletus dryadeus*, while Fries in 1821 first named it *Polyporus dryadeus*. Since then repeated references to this fungus have been found in European mycological literature, but nothing was written concerning the rot produced by it till Robert Hartig in 1878 described a heart rot of oak which he attributed to *Polyporus dryadeus*. A careful study of Hartig's figures and of his description of the sporophore, which he found associated with the heart-rot so accurately described by him, is sufficient to convince anyone who is familiar with the true *P. dryadeus* that Hartig's fungus was not *Polyporus dryadeus*.

The fungus with its associated rot as described by Hartig is undoubtedly identical with the heart-rotting fungus known in America as *Polyporus dryophilus* and found by Hedgcock associated with a whitish piped rot in oaks. *P. dryophilus* has one character that is unique and not possessed by any other polypore known to the writer, viz., its sporophore has a hard granular sandstone-like core, exactly as described by Hartig in his article on *P. dryadeus*. This hard core extends back some distance into the tree in oaks. It is usually irregularly cylindrical while in the tree, but on its emergence from the tree it swells into a tuberous or spheroidal mass and finally occupies the central and rear portion of the fully matured sporophore. This core usually has white mycelial strands ramifying through it. The sporophore of *Polyporus dryophilus* therefore has normally three distinct kinds of structures: (1) the hard granular core; (2) the fibrous layer which surrounds this core except at the rear; (3) the layer of pores or tubes on its lower side. Specimens are often found, however, especially in the western part of the United States in which this fibrous layer is entirely absent between the tubes and the core.

The sporophore of *Polyporus dryadeus* never has this granular core; its context is nearly homogeneous and of a corky-fibrous structure. Another difference between these two species is the location of the sporophores on

[1] Published by permission of the Secretary of Agriculture.

the host tree. In *P. dryadeus* they are attached to the exposed roots or to the trunk of the oak at or very close to the ground, while in *P. dryophilus*, the sporophores are usually found higher on the bole of the tree.

Polyporus dryophilus is known in Europe under at least three different names, viz., *P. fulvus* Fries, *P. friesii* Bresadola, and *P. vulpinus* Fries. The last is the name given to the form of *P. dryophilus* found on species of Populus. Authentic specimens of *P. vulpinus* from Finland and Sweden were seen by the writer in the New York Botanical Gardens. The writer has also seen specimens of this fungus on species of Populus from three different localities in the United States, viz,. from Maine (in the New York Botanical Gardens), from New Hampshire (in the Herbarium of Harvard University), and from Colorado (in the Laboratory of Forest Pathology at Washington, D. C.). This fungus on Populus agrees in all essential characters with the form of *P. dryophilus* found on oak. The hard granular core is always present but is formed between the sapwood and the bark since the fungus is able to rot the sapwood as well as the heart wood of this host.

Through the kindness of von Tubeuf, the writer obtained a European specimen of Hartig's so-called rot of *P. dryadeus* in oak. It is undoubtedly the rot produced by *P. dryophilus*. The writer has repeatedly found the sporophores of the true *P. dryadeus* associated with a white sap-rot of the roots of oaks under such circumstances that there could be no doubt that *P. dryadeus* was the cause of this root-rot.

The roots and the stools of twenty oak trees attacked by this fungus were examined and the various stages of the rot studied. The disease was found in the forests of Arkansas, Texas, Oklahoma, Maryland, and Virginia.

The first evidence of the disease is a reddish brown discoloration of the inner bark and cambium. As the rot progresses, watery brownish areas appear on the surface of the sapwood and in its outer layers. This discoloration gradually spreads until the root is affected to its center. In the final stage of the rot, the color becomes white or creamy white. In all the uprooted trees examined, the disease began in the lower portion of the roots and spread upward toward the stool of the tree. The rotted roots become brittle and are therefore easily broken and the tree uprooted in a windstorm.

The rot in all the trees examined did not extend any distance into the heartwood of the trunk proper above the collar of the tree, even when the large roots were rotted throughout.

The writer found *Polyporus dryadeus* attacking the roots of *Quercus texana*, *Q. nigra*, *Q. alba*, *Q. velutina*, *Q. minor*, *Q. rubra*, and *Q. prinus*. No rhizomorphs of any kind were found associated with this rot, either beneath

the bark, or on the surface of the diseased roots, or ramifying in the adjacent soil.

Authentic specimens of *Polyporus dryadeus* from America, England, France, Germany, and Austria were examined by the writer and a careful comparison with the material used as the basis of this article showed that the American fungus under discussion is undoubtedly identical with the European plant known as *P. dryadeus*.

Polyporus dryadeus is therefore a root parasite on the oak producing a white sap and heart-rot in the roots.

In the majority of cases only old trees or trees much suppressed and growing under unfavorable conditions were found attacked by this fungus. The disease does not seem to spread readily to adjacent trees.

The writer in a subsequent article will give a more detailed discussion of this fungus.

U. S. DEPARTMENT OF AGRICULTURE
WASHINGTON, D. C.

CONTROL OF APPLE BLACK-ROT

FREDERICK A. WOLF

The fungus, *Sphaeropsis malorum* Peck, is quite widely known throughout the United States yet it is generally considered as of minor importance as a rot of apples. It more frequently manifests itself as a canker on the trunk and limbs, or as a leaf spot, being sometimes so severe as to result in the premature defoliation of the trees. Attention has recently been directed to it, however, because of its destructiveness as a fruit rot in certain commercial apple orchards in Northern Alabama. Since it is not apparent from available literature that there is any exact experimental data relative to its control, and since more or less serious annual losses are incurred from its ravages, some work upon its control, has been initiated. It is the present purpose merely to give in a preliminary way some general statements that seem to be warranted from the results already obtained.

These experiments are being conducted near Fort Payne, Alabama, in an orchard of eight thousand trees, consisting in the main of Black Ben Davis, Champion, Delicious, and Early Harvest, of which the first appears to be the most susceptible to black rot. These trees are vigorous, well pruned, remarkably free from cankers, and the ground is in an excellent state of cultivation. Very considerable losses were occasioned in this orchard, in 1912, from bitter rot. This disease together with black rot seems to over-winter, so far as present observations go, on mummified and fallen fruits. A power sprayer, in which a pressure of two hundred pounds was maintained, has been used throughout the operations.

During last season commercial lime sulphur alone was used as a fungicide. Suffice it to say that it proved entirely ineffective against either black rot or bitter rot, irrespective of the time of application and the number of applications, hence its use cannot be recommended, at least under southern conditions. During the present season Bordeaux mixture, 4–4–50, has been used. The first application was made about the middle of July, upon the first appearance of the disease as a small dark spot in the bud end of some of the apples. A second application was made two weeks later to insure complete protection against subsequent infections. Most satisfactory results were obtained from this work, in view of the fact that the number of diseased fruits, upon the Champions, was less than one per cent. Only 85 per cent to 90 per cent control was obtained with Black Ben Davis. This loss could, no doubt, have been lessened had the first

application been made ten days earlier. The losses from bitter rot were inappreciable although this disease entailed severe losses in some sections of the state.

These investigations have definitely shown that the black rot of apples can be controlled in Alabama by the timely application of Bordeaux mixture. Waite controlled the disease in 1901, and Scott in 1905, in connection with bitter rot experiments[1] in Virginia. Two applications only of 3–3–50 Bordeaux mixture were required. In view of the fact that apples adjacent to old mummies are generally the first to show the disease, there is no doubt that they are the primary source of infection. Further, the affected leaves do not seem to be responsible for the spread of the disease to the fruits, since mature pycnidia seem to occur only on old fallen leaves. On this account sanitary measures relative to the collection and destruction of all diseased fruits, both fallen specimens and mummies, cannot be too strongly recommended. If, in addition, the leaves are plowed under during winter or early spring, one may reasonably expect very effective black rot control from two timely applications of Bordeaux mixture.

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[1] Scott, W. M., and Rohrer, J. B., Apple leaf spot caused by Sphaeropsis malorum. U. S. Dept. Agr., B. P. I. Bul. 121: 47–54. 1908.

PHYSALOSPORA CYDONIAE

LEX R. HESLER

WITH PLATE XXV AND TWO FIGURES IN THE TEXT

In connection with studies on the New York apple tree canker several interesting problems have presented themselves. Among these may be mentioned: parasitism of *Sphaeropsis malorum* Berk.,[1] the identity of the organism, the comparison of different strains or races, the relationship of Sphaeropsis to Diplodia, and the question of the perfect stage. The object of this paper is to discuss the ascomycetous form of the fungus and to present the results of the investigation.

Fückel[2] in his description of *Otthia pyri* states that the pycnidia are very similar to those of *Diplodia pseudo-diplodia* and *Diplodia malorum*. Delacroix[3] is of the opinion that the former species is the same as *Sphaeropsis malorum* Pk. and unites the two under the name *Sphaeropsis pseudo-diplodia* (Fückel) G. Del. The justification of this move will not be discussed here. It is desired merely to call attention to Fückel's suggestion that *Otthia pyri* may be the perfect stage of the pycnidial form in question. Shear[4] cultured ascospores of *Melanops quercuum* [*Botryosphaeria fuliginosa* (M. & N.) E. & E.] and obtained pycnidia bearing spores of the Macrophoma or Dothiorella type which later turned brown and some of which became once-septate, corresponding to *Sphaeropsis viticola* Pass. and *S. peckiana* Thüm. He states further that these spores also agree morphologically with *S. malorum* Pk. and *D. pseudo-diplodia*. In a few cases he found another form of pycnospore in the same pycnidium with the Sphaeropsis spores; these were small, hyaline, cylindrical, 2 to 3 by 1μ, and were observed in the hosts and not in the cultures. Arnaud[5] observed an ascomycete associated with *S. pseudo-diplodia* (Fückel) G. Del. which he named *Physalospora cydoniae* Arnaud. His opinion, based en-

[1] The synonomy is given by Edgerton, C. W., Two little known Myxosporiums. Ann. Myc. **6**: 48–53. 1908.

[2] Fückel, Symboliae Mycologicae **1869**: 307.

[3] Delacroix, G., Sur l'identite reele Sphaeropsis malorum Pk. Bul. Soc. Myc. France **19**: 350–352. 1903.

[4] Shear, C. L., Life history of Melanops quercuum (Schw.) Rehm. forma vitis Sacc. Science n. s. **31**: 748. 1910.

[5] Arnaud, G., Notes phytopathologiques. Ann. L'Ecole Nat. Agr. Montpellier **12**: 9. 1912.

tirely on association of the two organisms, is that the latter is the perfect stage of the former. He makes no mention of pure culture work with which to verify his statements.

The writer has made repeated attempts to find the ascogenous form of *Sphaeropsis malorum* Berk. but had been unsuccessful until a few months ago. Affected leaves which had over-wintered on the ground of badly infested orchards have been examined, but these showed only the pycnidial form of the fungus. The older portions of the cankered spots also have been examined but these likewise failed to reveal the desired stage. Again affected leaves, twigs (some exposed and some others in jars,) and pure cultures from pycnospores on various solid media (potato agar, oat agar, etc.), have been over-wintered with the hope that the perithecia might be developed. So far, however, such fruit bodies have never appeared.

In February, 1913, diseased apple twigs were received at the Department of Plant Pathology at Cornell University from the Stark Brothers Nurseries and Orchards Company, Louisiana, Missouri. It has since been learned that the specimens originally came from Croton-on-Hudson, New York. Free-hand sections and crushed mounts, in the majority of cases, showed only the pycnidial stage of *Sphaeropsis malorum* Berk. Occasionally, however, an immature ascomycete was observed. The twigs were placed in a moist chamber and, after a few days, mature asci were developed. Small bits of bark were imbedded in paraffin, and were subsequently sectioned and stained. Fortunately a very few perithecia were present on the prepared slides. Further search on one of these twigs revealed a few perithecia which, while standing entirely separate from one another, were more or less grouped in local regions on the bark. The ascospores were isolated and cultured at once.

Two methods of isolation were used. In the one case, single perithecia were removed, under the hand lens, with a flamed scalpel and promptly placed in a petri dish in a drop of sterile water. They were subsequently crushed and the plate poured with warm agar. A gentle shaking of the dish was sufficient to scatter the spores and asci. In some cases single ascopores, in others single asci bearing mature spores, were marked by aid of the low power of the microscope. Germinations followed in a few hours. Single spores or asci were then transferred to sterile tubes or flasks of agar and allowed to grow. The second method followed in isolating was by a modification of the process described by Barber.[6] Perithecia were crushed in a drop of sterile water on a flamed slide and the mount placed under the low power of the microscope. A small glass rod, about fifteen or twenty cm. in length and with a bore of about 3 mm. was drawn to a cap-

[6] Barber, Marshall, A., On heredity in certain microörganisms. Kansas Sci. Bul. **4**: 3–48. pls. 1–4. 1907.

illary tip at one end; to the opposite end was fitted a piece of rubber tubing, about 40 or 45 cm. in length. The free end of the latter was placed in the mouth while the former was manipulated by the hand. By careful handling of the apparatus it was possible to pick out single ascopores. These were then planted in a drop of sterile water in a petri dish and the plate poured as in the first method of isolation. Further procedure was as in the first method.

On March 6, 1913, six plantings of ascospores in as many plates of +10 nutrient agar [7] were made. On the same date several cultures of pycnospores from the same twig were also made using the same kind of media. The ascospore cultures grew slowly the hyphae remaining grayish in color. After sixty days the mycelium had covered only about two-thirds of the surface of the dish, with no evidence of fruiting (pl. XXV, fig. 8). The mycelium in the cultures from pycnospores grew rapidly, soon turning dark brown in color. Pycnidia bearing mature spores appeared after a period of about one week (pl. XXV, fig. 8). On March 10, 1913, bits of mycelium from the edge of the ascospore cultures were transferred to Erlenmeyer flasks containing oat agar. At first the color of the growth was grayish, as on the nutrient agar, but soon it became dark brown. On April 19, pycnidia were observed; they proved to be similar to those obtained in culture from pycnospores. The original ascospores cultures on nutrient agar were allowed to grow until they had dried out but no fruit bodies developed. Subsequent transfers were made from the ascospores cultures on nutrient agar under the following dates with results as indicated: April 15, to oat agar,[8] mature pycnidia after eight days; April 28, to oat agar, pycnidia after ten days; April 28, to potato agar,[9] pycnidia after eighteen days or less.

Isolations of ascospores were made again on April 16, 1913, using potato agar instead of nutrient agar; after twelve days mature pycnidia were found. Subcultures to oat agar developed pycnidia after a few days. Again, isolations of ascospores on April 17 and April 23 in potato agar, developed pycnidia within eleven days.

It should be noted that pycnospores and ascospores have very different types of growth on nutrient agar. To verify these results cultures were made as follows: (1) Ascospores isolated on March 6, 1913, gave only scant growth on nutrient agar; (2) transfers from (1) to oat agar on March

[7] This medium was made according to the directions given in Frost, W.D. A Laboratory Guide in Elementary Bacteriology. 3rd Ed.: 16. 1907.

[8] Oat agar made according to G. P. Clinton. Report of Botanist. Conn. Agr. Exp. Sta. Rept. **1909–1910** : 760–761. 1911.

[9] Formula for potato agar: Wash and pare one medium sized potato and cook in double boiler for an hour. Filter and to filtrate add five grams of glucose, thirty grams of agar and make up to 1000 cc. with distilled water. Cook thoroughly over free flame, tube and sterilize.

10 showed fruiting in a few days; (3) transfers from (2) on April 15 and April 28 back to nutrient agar, gave again only a scant growth as in (1); and (4) transfers from (3) back to oat agar gave pycnidia in a few days.

In any such culture work contaminations are likely to bring about misleading results. It appears, however, that if in the original transfers of ascospores to nutrient agar pycnospores had also been carried, the resulting culture would have shown semblance to that obtained by planting pycnospores. In any case the growth from subsequent transfers make it very apparent that this possibility was eliminated.

During the past summer several inoculations have been made with cultures from the ascospores of the ascomycetous fungus. The apple, pear, quince, crab apple, and other plants were inoculated, in each case wounds being made to serve as infection courts. Three varieties of apples, namely Twenty Ounce, Baldwin, and Chenango Strawberry, were inoculated between May 20 and July 16, 1913. Eleven sets of experiments involving about seventy incisions were made, all of which gave positive infections, the checks remaining healthy (pl. XXV, figs. 2 and 3). On Duchess pear limbs only one set of inoculations, involving nine incisions, was made, but cankers were produced in every case, some of them attaining greater size than those produced on apple (pl. XXV, figs, 4, 5, and 6). The results on quince were unsatisfactory since but one infection was obtained out of five inoculations. On crab-apple twigs three incisions gave positive results, while all other attempts to infect failed on the several plants inoculated.

In June, 1913, an ascomycete on *Hamamelis virginia* was found. It so so closely resembled morphologically the ascomycete on apple twigs that cultures were promptly made. Isolations on June 2, in potato agar, with sub-cultures on oat agar, gave pycnidia after fifteen days; they were morphologically similar to those of *Sphaeropsis malorum* Berk. On June 20 a second isolation gave pycnospores after about ten days. About twenty-five different inoculations were made on all the plants mentioned above but no infections occurred. It is difficult to explain the failure of these inoculations. However, it is possible that there are biological races in the ascomycetous stage.

The perithecia are usually scattered, standing separate from one another. Sometimes, owever, two to four fruit bodies are aggregated together, but no stroma has ever been observed. They are buried in the cortical tissues, protruding at maturity by a short, papillate ostiole. Their form is globose to sub-globose, measuring in the vertical diameter from 180 to 324 by 300 to 400μ in the horizontal diameter, averaging about 225 to 325μ (fig. 1).

The asci are abundant; they are usually clavate, though sometimes

tending to be cylindrical, measuring 21 to 32 by 130 to 180μ. The tip of the ascus is thickened, however a complete canal from the inner wall to the outside has not been observed; only a suggestion of such has been seen even after the perithecia had been kept in a moist chamber for several hours (fig. 2). Examinations made at short intervals show that there is probably a gelatinization of the asci and that the spores escape subsequent to this process. At the apex of a perithecium, which has been subjected to moist chamber conditions, may be found a whitish, gelatinous mass which is only the ascospores imbedded in a gelatinous substance. If free-hand sections are made, the basal portion of such a fruit body shows a gelatinous mass in which are buried a few ascospores and what appear to be the remains of the old asci.

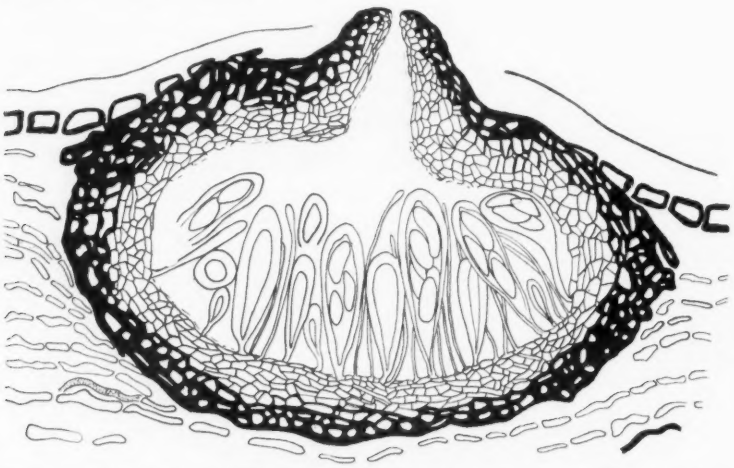

FIG 1. Perithecium of Physalospora cydoniae. Camera lucida drawing

The ascospores are ellipsoidal or often they are inequilateral (fig. 2). They are hyaline to greenish-yellow, measuring from 10.8 to 15.2 by 23.4 to 34.2μ averaging 11.5 by 28μ. In the dry condition the material shows spores with a very thin gelatinous sheath, but after being under a saturatured atmosphere for a few hours, the sheath becomes very broad and evident. The arrangement of the spores in the ascus tends to be more or less biseriate (fig. 2). Germination has been easily obtained in water and in nutrient, potato and oat agars. Paraphyses are distinct and are occasionally branched near the tip. Not infrequently the apex shows a tendency to be clavate (fig. 2).

The characters just described seem to relate the fungus to the genus Physalospora. The presence of the gelatinous sheath about the spores suggests the family Massariaceae. However, this character is not pro-

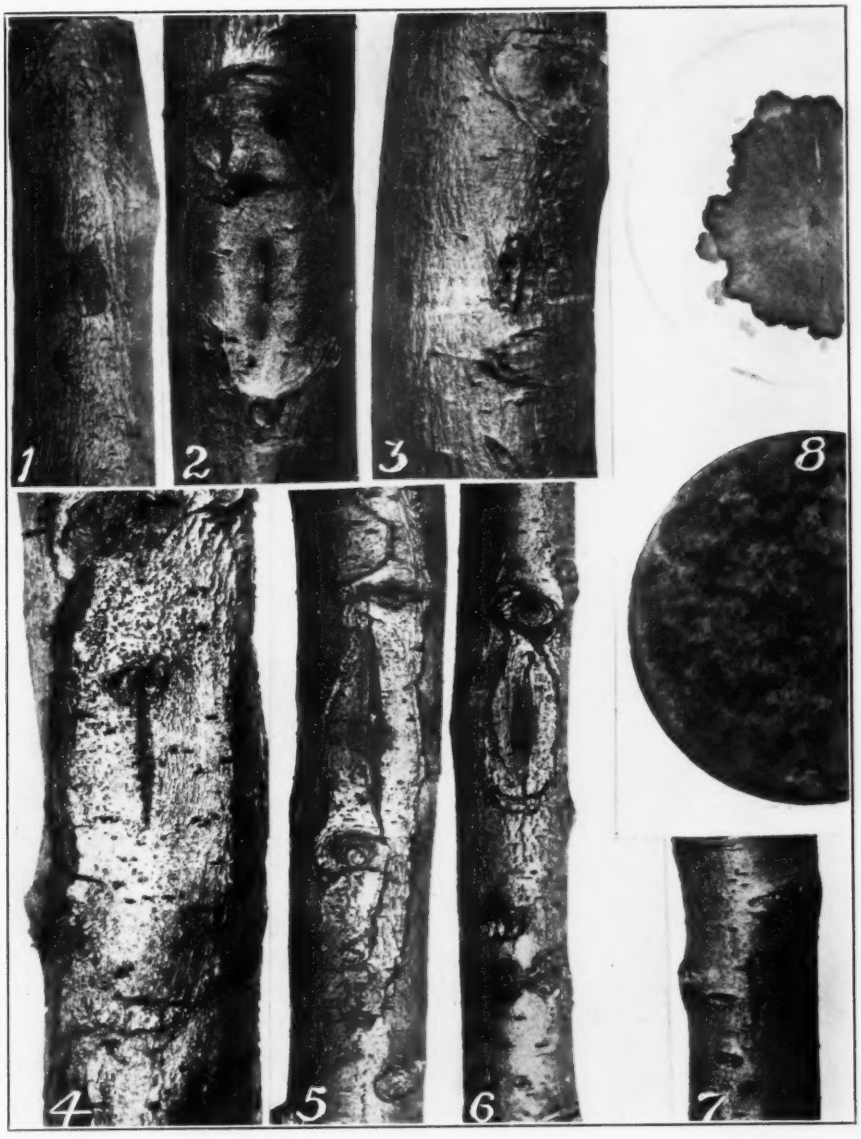

PLATE XXV. PHYSALOSPORA CYDONIAE: INOCULATIONS AND CULTURES

FIG. 1. Apple limb three months after inoculation with the ascomycete from Hamamelis.

FIG. 2. Apple limb two months after inoculation with ascomycete from apple.

FIG. 3. Check.

FIG. 4. Pear limb three months after inoculation with ascomycete from apple. Slightly enlarged to show pycnidia.

FIGS. 5 and 6. Same, except that pycnidia have not appeared.

FIG. 7. Check on pear limb.

FIG. 8. Showing the stunted growth, above, of mycelium from ascospores on +10 agar, and growth, below, from pycnospores on same kind of medium.

nounced in the dry condition and is not regarded as sufficient to warrant classification in this family. According to Winter[10] in certain species of Physalospora, e.g., *P. festucae* (Lib.) Sacc. and *P. fallaciosa* Sacc., a thin gelatinous sheath is present about the ascospores, so that the species we have under consideration is not exceptional in this respect.

Ellis and Everhart[11] in their discussion of *Botryosphaeria fuliginosa* (M. & N.) E. & E. state that forms of the species lacking a stroma have been removed to the genus Physalospora. Until a more satisfactory system of classification is at hand, there seems to be no serious objection to the generic name which the writer has selected.

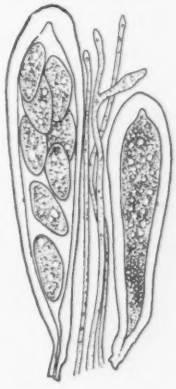

FIG. 2. Asci and paraphyses. Camera lucida drawing.

The problem of selecting a specific name is somewhat perplexing. The organism with which the writer is dealing strongly resembles *P. cydoniae* Arnaud but we have not seen his type material and there remains the question of whether his fungus has not been previously described. In this connection a few species which suggest this possibility may be noted: *P. entaxia* E. & E. *P. festucae* (Lib.) Sacc. and *P. nigropunctata* Romell, the last on limbs of *Pyrus malus* according to Saccardo.[12] Until further data are at hand the writer is inclined to accept tentatively the name *Physalospora cydoniae* Arnaud. With regard to *Melanops quercuum* (Schw.) Rehm forma *vitis* Sacc. discussed by Shear, it may be said that this organism clearly belongs to a stroma-forming group of Sphaeriales, and would appear to be a different form than *Physalospora cydoniae* Arnaud. It has been mentioned elsewhere in this paper that Shear found another form of pycnospore intermingled with the Sphaeropsis spores on the host. No such structures have ever been observed in the organism studied by the writer.

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[10] Winter, G., Die Pilze. Rabenhorst's Krypt-Flora **2**: 410. 1887.
[11] Ellis, J. B. and Everhart, B. M., North American Pyrenomycetes. p. 547. 1892.
[12] Saccardo, P. A., Sylloge Fungorum **13**: 873. 1898.

THE RELATIVE PREVALENCE OF PYCNOSPORES AND ASCOSPORES OF THE CHESTNUT BLIGHT FUNGUS DURING THE WINTER[1]

F. D. Heald and M. W. Gardner

With Plates XXVI, XXVII and XXVIII

INTRODUCTION

In studying the dissemination of the chestnut blight fungus we have endeavored to determine the relative importance of pycnospores and ascospores in the spread of the disease. Since the pycnospores had generally been designated as "summer spores," and the idea had been rather generally prevalent that they were abundant only at the seasons of the year when "spore horns" were evident, it seemed desirable to determine by some careful analyses the extent to which they were produced during the winter months, when "spore horns" were entirely absent or but rarely found.

The common idea concerning the two types of spores is expressed in the following statement from Murrill:[2]

"Later the fruiting pustules push up through the lenticels and give the bark a rough warty appearance; and from these numerous yellowish-brown pustules, millions of minute summer spores emerge from day to day in elongated reddish brown masses, etc. In late autumn the winter spores are formed, which are disseminated from the dead branches the following spring."

Hodson[3] states, "The yellow fruiting bodies so common on the diseased trees are constantly giving off millions of summer spores all through the growing season." The natural inference from this statement would be that the summer spores are not prevalent during the periods unfavorable to growth.

Refering to the production of ascospores, Mickleborough[4] states, "In this way the fungus tides over the winter," and then follows a mention of the "summer spores or conidial spores" to be found in early spring and during the summer.

[1] Investigations conducted in coöperation with the Pennsylvania Chestnut Tree Blight Commission.

[2] Murrill, W. A. Journal New York Botanical Garden **7**: 146. 1906.

[3] Hodson, E. R. Extent and importance of the chestnut bark disease. Circular (unnumbered) U. S. Dept. Agr. Forest Service, p. 5. 1908.

PYCNOSPORE TRAPS

In this work we have used what we have designated as a pycnospore trap, to catch and retain at least a part of the pycnospores washed down from a blight lesion during a rain. These traps were also designed to catch other spores, but they were designated as "pycnospore traps" since we have used an entirely different form of trap, the "ascospore trap," for detecting the expulsion of ascospores. The trap (pl. XXVI) consisted of a brass curtain screw (*s*) turned into the bark or trunk of the branch so as to stand at right angles to the surface; a glass object slide (*o*) set into a transverse groove in the bark and held by the screw at an angle of about 45 degrees; and a more or less compact mass of absorbent cotton (*c*) between the lower end of the slide and the vertical arm of the screw. The trap was always set below a lesion bearing fruiting pustules (*l*), in such a position that a part of the rain water flowing over the lesion would be conducted down the object slide and through the absorbent cotton (pl. XXVII and XXVIII). Traps were set at two different localities: 6 at West Chester, Pa. and 8 at Martic Forge, Pa. Those located at West Chester were set during a rain, and were so placed as to intercept a noticeable stream. Those at Martic Forge were not set during a rain and consequently were not as favorably located.

METHOD OF MAKING AN ANALYSIS

After each rain period the cotton from each trap was removed and placed in a sterile Petri dish for transport to the laboratory at the University of Pennsylvania where the analyses were completed. A new mass of cotton was put into place to be ready for the next rain. The cotton of each trap was introduced by means of sterile forceps into an Erlenmeyer flask containing 100 cc. of sterile water. Each flask was then shaken vigorously so as to set free all or as many as possible of the contained spores. In the earlier analyses 1 cc. or a fractional part of 1 cc. of the wash-water was placed in each Petri dish and the melted medium added, but the plates were always so heavily seeded with bacteria and rapid growing fungi that the much slower growing colonies of the blight fungus were completely overrun before they were large enough to count. It soon became evident that a much greater dilution would be necessary in order to lessen the number of rapid growing forms in each plate and give a satisfactory separation of the spores of the blight fungus. In all of the later work 1 cc. of the original wash-water was introduced by means of a sterile 1 cc. Mohr pipette into a second Erlenmeyer flask containing 99 cc. of the sterile water. The second

[4] Mickleborough, John. A report on chestnut tree blight. Pa. Dept. of Forestry, p. 10. 1909.

flask was shaken well and with another sterile pipette 1 cc. of this dilution or a fractional part, was introduced into the Petri dish to be used in making the culture. This method is illustrated in pl. XXVI, and it may be noted that the number of colonies of the blight fungus appearing in the culture represents 1/10000 of the total number of viable spores retained by the cotton. In many cases it was necessary to use even a fractional part of a cubic centimeter from the second flask in order to secure a sufficiently small number of spores of the blight fungus to give a reliable count.

The water containing the spores was always introduced into the sterile Petri dishes, and the melted medium cooled to 42° to 45°C, poured the same as in making a bacteriological analysis of water. Three per cent dextrose agar, plus 10, was employed in all of the analyses. The plates were incubated as nearly as possible at 25°C and the colonies suspected of being blight were marked at the end of four days. Their later development was then followed to substantiate the diagnosis. It was possible to determine by the time of appearance of the colonies that they originated from pycnospores rather than ascospores. This method is described in detail elsewhere.[5]

THE TRAPS AT WEST CHESTER

The pycnospore traps at West Chester were set on trees 4 to 8 inches in diameter, in a badly diseased coppice growth of native chestnut. Trees were selected so as to give varying conditions of the lesions, but perithecia were present in different stages of development from young to mature ones in the lesions located above the traps (pl. XXVII). Pycnidial pustules were, however, more abundant than the perithecial pustules. Additional facts recorded are given in table I.

ANALYSES BASED ON TRAPS AT WEST CHESTER

The pycnospore traps were set at West Chester, January 8, 1913, but satisfactory analyses were not obtained until the rain of January 17. Weather instruments were installed near the grove in a standard U. S. Weather Bureau instrument shelter. A Friez standard rain gage and a Friez thermograph were employed. The results of analyses of the traps at West Chester are given in table II.

THE TRAPS AT MARTIC FORGE

The pycnospore traps at Martic Forge were set on Paragon chestnut trees 5 to 13 inches in diameter, that had been grafted on native stock.

[5] Mycologia **5**: 274–277. September, 1913.

TABLE I

Traps at West Chester

	NUMBERS OF TRAPS					
	I	II	III	IV	V	VI
Orientation	SW	S	S	SE	S	S
Height from ground	3 ft.	4½ ft.	3½ ft.	4 ft.	2 ft.	4 ft.
Diameter of trunk at trap	4 in.	7 in.	6 in.	5 in.	7 in.	5 in.
Condition of branch or trunk above lesion	Dead	Dead	Alive, many dead limbs	Alive, few dead limbs	Dead	Alive, few dead limbs
Lesions above trap	Infection general	Infection general	Many	2 large ones on trunk 3 at base of branches	Infection general	Many. 6 large on main trunk. Many others on limbs (fig. 2)

The cankers above the traps were from one to three years old and showed the fruiting pustules in various stages of development. There were many mature perithecial pustules as well as an abundance of pycnidial pustules. The perithecia were more abundant than in the lesions tested by the traps at West Chester. Additional facts recorded for each trap are given in table IV.

ANALYSES BASED ON TRAPS AT MARTIC FORGE[6]

The pycnospore traps were set at Martic Forge, Pa., January 28, 1913, but satisfactory analyses were not obtained until the rain of February 12. A set of weather instruments similar to those used at West Chester was installed in the orchard. The results of the analyses of the Martic Forge traps are given in table V.

THE EFFECTIVENESS OF THE COTTON TRAPS

The cotton of the traps was collected as soon as possible after the rain in order to lessen any possible loss from desiccation. In some cases the cotton was frozen when collected, as the winter rains were not infrequently

[6] The field work at Martic Forge was done by Mr. C. E. Taylor, formerly in the employ of the Pennsylvania Chestnut Tree Blight Commission. He also assisted in making the analyses.

TABLE II

Summary of pycnospore trap records, West Chester, Pa.

DATE COLLECTED 1913	RAINFALL REPRESENTED	TRAP NUMBERS AND NUMBER OF VIABLE PYCNOSPORES OBTAINED					
		I	II	III	IV	V	VI
	inches						
1/9	0.29						
1/11	0.13						
1/15	0.24						
1/17	0.81	12,950,000	Present	925,000	999,000	45,000	1,750,000
1/20	0.31	4,200,000	Present	Present	Present	Present	351,000
1/29	0.24	17,325,000	6,440,000	1,820,000	426,000	15,120,000	2,625,000
1/29	0.88	66,255,000		6,890,000	1,170,000	77,220,000	18,975,000
2/12	0.15	12,900,000		9,700,000	85,550	20,900,000	923,850
2/22	0.19	92,235,000	29,700,000	57,015,000	6,030,000	737,500	31,950,000
2/24	0.07	35,640,000	1,720,000	10,560,000	590,000	40,000	11,220,000
2/28	0.78	37,345,000	12,000,000	6,550,000	1,095,000	4,185,000	5,050,000
3/10	0.03		1,110,000	10,000		1,170,000	10,000
3/11	0.53	54,210,000	10,500,000	87,650,000	5,900,000	68,770,000	103,410,000
3/15	1.18	5,425,000		2,325,000	1,850,000	4,965,000	3,900,000
3/17	0.195	590,000	80,000	730,000	150,000	1,101,000	200,000
3/21	1.64	21,760,000	Present	4,600,000	9,100,000	26,400,000	37,700,000
3/28	1.18	18,700,000	18,900,000	8,800,000	5,200,000	21,780,000	22,840,000
3/31	0.05	100,000		28,980,000	101,000,000	580,000	18,560,000
4/5	0.56	49,770,000		97,650,000	38,430,000	129,280,000	57,120,000
4/14	2.49	540,000		1,855,000	315,000	246,000	1,680,000
4/17	1.57		3,182,000	516,000	106,000	1,488,000	3,956,000
4/28	2.43	936,000	180,000	176,000	810,000		704,000
4/30	0.11	32,560,000	86,000	52,480,000	470,000	756,000	1,575,000

TABLE III

Temperature records at West Chester, Pa. January, February, March, April, 1913

	JANUARY		FEBRUARY		MARCH		APRIL	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
1	50	34	37	16	48	34.5	55	39
2	52	30	29	11	41	23	58	38
3	58	37	31	24	45	19.5	70	41.5
4	39	27	30	19	58	35	76	44
5	38	30	24	15	45	28.5	64	41
6	55	32	23	7	45	16.5	43	32
7	57	50	24	5	21	12.5	45	30
8	60	36	32	15	34	10.5	49	28
9	38	18	31	14	64	31	53	33
10	40	22	21	14	49	37	47	27
11	54	35	35	17	48.5	36	58	39.5
12	59	32	34	11	54	29	58	53
13	34	20	24	7	54.5	34	57	51
14	40	26	36	7	64	52	55.5	51
15	45	26	45	17	65	55	54	47
16	46	37	50.5	21	62	30	52	42
17	61	43	31	26	37	24	67	41
18	57	48	34	17	49	30	68	34
19	49	33	22	21	63	27	67	43
20	54	33	50.5	25	63	49	50	33
21	60	29	58	40	73	53	57	29
22	41	22	58	45	58	31	69	30
23	44	28	45	22	49	26	72	44
24	45	36	31	21	69	47	78	53
25	48	30	28	15	75	61	78	49.5
26	55	26	38	15	69	58	73	49
27	43	27	60	38	68	30	62	51
28	35	20	62	40	42	26.5	59	48
29	31	22			49	22	56	49
30	47	24			57	30	66	43
31	57	38			70	42		

followed by freezing temperatures. We have proved by experiments that freezing has little effect upon the viability of pycnospores in water.

When this device for collecting the spores was selected it was not with the idea that the cotton would retain all of the spores in the rain water passing through, but simply that the mass of cotton would hold a certain amount of rain water bearing spores in suspension. The numbers given in the analyses bear no relation to the amount of rainfall and represent only a small part of the number actually washed through the traps.

During the rain of March 15, some of the water flowing into traps one and three at West Chester was collected and the number of pycnospores

TABLE IV

Traps at Martic Forge

	NUMBERS OF TRAPS							
	I	II	III	IV	V	VI	VII	VIII
Orientation	NE	SE	W	W	SE	W	SE	NE
Height from ground	2.5 ft.	1.5 ft.	3.5 ft.	3 ft.	2 ft.	5 ft.	5.5 ft.	3.5 ft.
Diameter of trunk at trap	6.5 in.	5.5 in.	7 in.	5 in.	7 in.	7 in.	6 in.	6.5 in.
Condition of branch or trunk above lesion	Dead	Alive, but nearly girdled	Dead	Dead except one 2.5 inches branch	Dead	Alive. Only little infected	Alive, but three-fourths girdled	Alive, but badly diseased.
Lesions above trap	Infection general for 2 feet above	One 12 x 14 inches just above; two others higher up not in line with trap	One nearly girdling trunk just above trap; three higher	One 10 x 9 inches just above. Another few in. higher on same side; two others higher	One just above completely girdling trunk. Pustules general for 3.5 feet above trap	One lesion 8 feet from trap	One lesion 9 x 9 inches just above	One lesion 15 x 16 inches just above trap. One other 1 foot higher but lateral.

TABLE V

Summary of pycnospore trap records, Martic Forge, Pa.

DATE COLLECTED 1913	RAINFALL REPRESENTED	TRAP NUMBERS AND NUMBER OF VIABLE PYCNOSPORES OBTAINED							
		I	II	III	IV	V	VI	VII	VIII
	inches								
2/4	0.06								
2/12	0.03	190,000	110,000	60,000	30,000		120,000		70,000
2/24	0.09	55,000	199,500	235,000	995,000	2,910,000	145,000	2,870,000	385,000
2/28	0.36		180,000	870,000		220,000	130,000	290,000	10,000
3/6	0.02			30,000				120,000	
3/11	0.55		1,210,000	475,000	20,000		635,000	690,000	150,000
3/14	1.29		285,000	3,030,000	60,000	125,000		210,000	55,000
3/17	0.92	1,400,000	385,000	875,000	230,000	335,000		235,000	30,000
3/21	0.62	100,000	470,000	500,000		1,120,000	40,000	1,030,000	
3/28	3.47		900,000	1,510,000	1,160,000	190,000	30,000	560,000	50,000
4/3	0.14		5,220,000		170,000	13,900,000	1,180,000		70,000
4/7	0.23			3,850,000	20,000			3,650,000	
4/11	0.55	100,000	10,000	14,270,000		450,000	880,000	1,090,000	50,000
4/15	1.23			16,850,000	505,000	185,000		170,000	90,000
4/17	1.15	10,000	59,000	20,000	86,000	59,000		146,000	
4/30	2.40	174,000	850,000	5,435,000	1,860,000	408,000		944,000	674,000

TABLE VI

Temperature records at Martic Forge, Pa., February, March, April, 1913

	FEBRUARY		MARCH		APRIL	
	Max.	Min.	Max.	Min.	Max.	Min.
1	42	21	46.5	30	54	40
2	37	17	40	19	58	42
3	37	32	49	19	74	39.5
4	36	27	61	43	80	54
5	32	23	44.5	30.5	59	40
6	27	16	43	17	42	32
7	31	12	21	12	49	33
8	39	24	35	9.5	52	27
9	38.5	19.5	66	35	55	31.5
10	30	17.5	52	41	50	34
11	42	23		38	57	41.5
12	39	14.5	46	27	58	54
13	30.5	10	55	46	57	51
14	41.5	12.5	67	53	58	51
15	51	25	61	53	55	49
16	57	31	53	31	59	45
17	39	29	38	32.5	69	40
18	36	18.5	51	24	72	42.5
19	45.5	21.5	65	35	68	43
20	57	29.5	66	49	54	35
21	59	45	68	55	59	33
22	56	48.5	59	29	77	37
23	48	24	55	25.5	77	49
24	30	19	71	50	83	52.5
25	28.5	15	78	61	84	57
26	38.5	13.5	69	58	80	55
27	58	38.5	65	29	66	49
28	61	37	43	24	62	45
29			51	20	54	46
30			59	38.5	67	35
31			69	44		

per cubic centimeter determined. The water from trap 1 yielded 302,400 and trap 3 gave 131,000 per cubic centimeter. The cotton of the trap would hold 15 to 20 cc. of water when saturated. The analysis for trap 1 on this date showed 5,425,000 spores or the number that would have been in suspension in 17.94 cc. A test made in the laboratory would also substantiate these results. 94,871,500 pycnospores were passed into a cotton trap and only 2.9 per cent were retained by the filtering action alone. We must conclude then that the figures given in the tables are but a meager expression of the vast number of pycnospores washed down from the cankers with each rain.

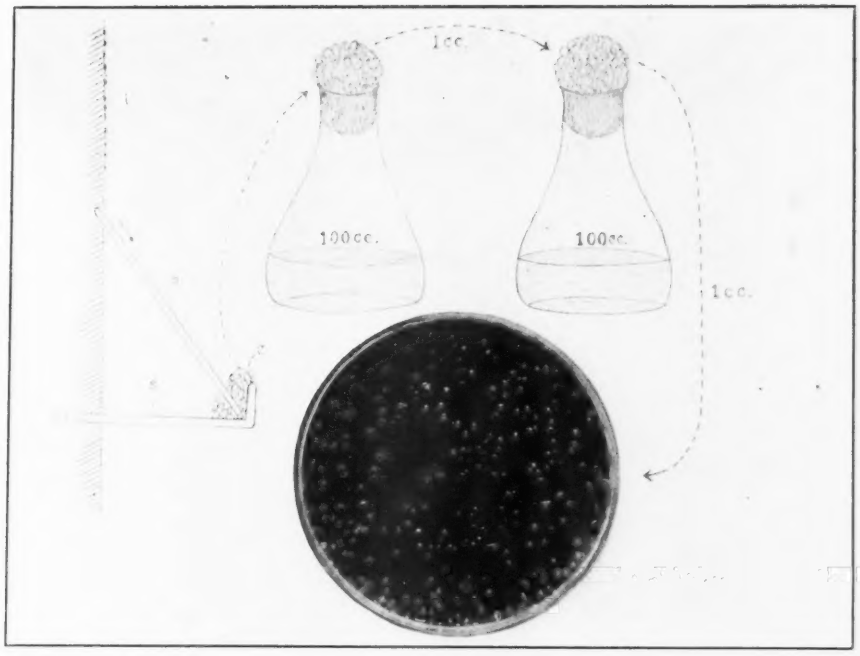

PLATE XXVI. A SPORE TRAP

The diagram shows a pycnospore trap and the method of making an analysis. (*s*), brass curtain screw; (*o*), object slide with arrow indicating the downward flow of rainwater; (*c*), mass of absorbent cotton; (*l*), lesion in bark of tree. The plate culture shown is one of the West Chester series and shows but few foreign colonies.

PLATE XXVII. A SPORE TRAP

Pycnospore trap No. 6, at West Chester, showing relation to large lesion immediately above it.

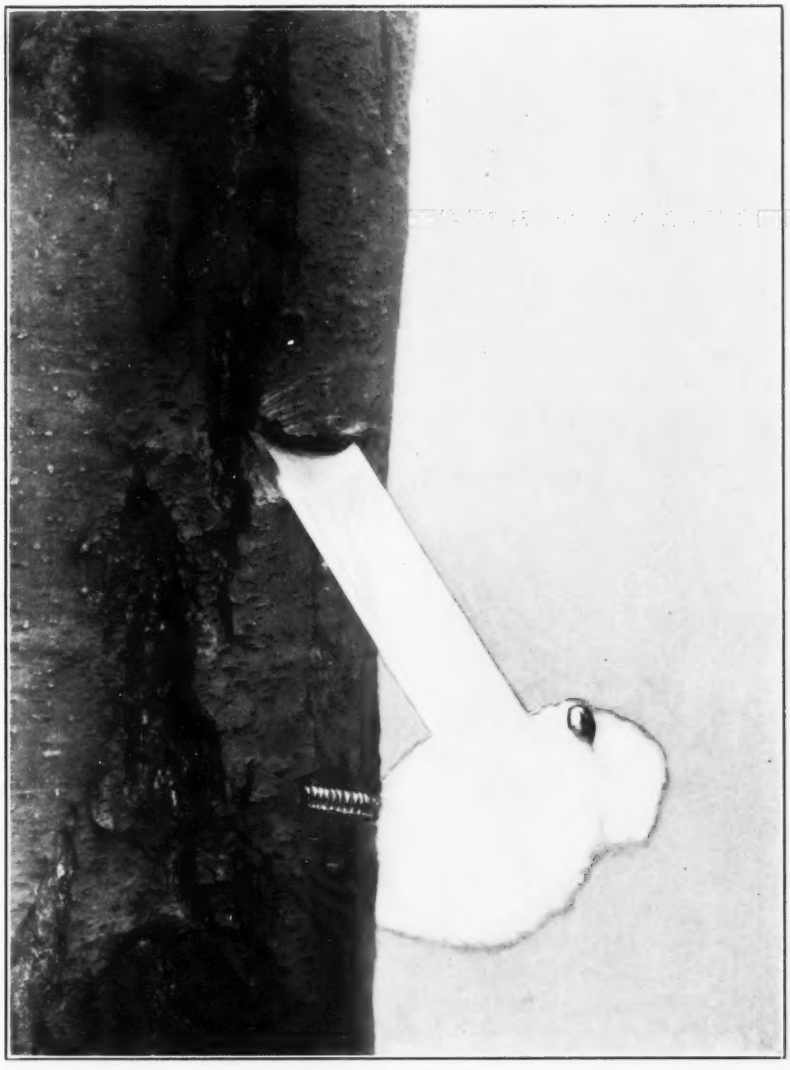

PLATE XXVIII. A SPORE TRAP

Pycnospore trap No. 6, at West Chester. Side view, nearly natural size

MICROSCOPIC EXAMINATION OF CENTRIFUGED SEDIMENTS

A portion of the water in which the cotton was washed was always centrifuged to throw down any spores which might be present, and the sediment was retained for microscopic examination. In case the microscopic examination was not made at once, the centrifuged sediment was preserved by the addition of formalin. The microscopic examinations involved a large amount of work, but it was thought best to employ this as a check to the results obtained by the plate cultures. Whenever the plate cultures showed the presence of the blight fungus, pycnospores could always be found in the centrifuged sediments, but *ascospores were uniformly absent.* This substantiates the results obtained by the plate cultures, as none gave an indication of colonies which originated from ascospores. The spores of various other fungi were present in the sediment, but no general attempt was made to identify them. A species of Coryneum, probably the conidial stage of *Melanconis modonia*, was found at all times during the period covered by the analyses.

CONCLUSIONS

The analyses from the traps at both West Chester and Martic Forge show that viable pycnospores of the chestnut blight fungus were washed down the trees in enormous numbers during every winter rain. This was at a time when visible "spore horns" were absent or but rarely produced. These results are somewhat contrary to the generally accepted view, since pycnospores have generally been designated as "summer spores." It may be noted that the past winter was one of unusual mildness, but taking even this into consideration the results obtained point to the conclusion that pycnospores are prevalent throughout the entire year, and that the production of "spore horns" is but a visible index of their maximum production.

The analyses also show that ascospores were not washed down by the rains during the period covered by the tests. Detailed observations of field ascospore traps, to be published later in full, have shown that expulsion of ascospores is dependent upon temperature as well as moisture. There was no expulsion of ascospores under field conditions from late November until the rain of March 21, when temperature conditions were favorable. Ascospores were not expelled during the warm winter rains, and were not obtained in the traps for the few times when expulsion did take place.

FOREST PATHOLOGY LABORATORY
UNIVERSITY OF PENNSYLVANIA
PHILADELPHIA, PA.

THE INTRODUCTION OF A EUROPEAN PINE RUST INTO WISCONSIN

J. J. Davis

In September, 1912, Mr. J. G. Sanders, Entomologist of the Wisconsin Agricultural Experiment Station, while in performance of his duties as Nursery Inspector, observed a great abundance of rust on a certain weed at a locality near Sturgeon Bay, Wisconsin. Because of the abundance of the rust, he plucked a specimen and submitted it to the department of plant pathology of the University. In November, 1912, Mr. Sanders, at my request, wrote for additional material which was kindly sent, bearing then the telial as well as the uredinial stage. This additional material made possible the identification of the host as *Sonchus asper* (L.) Hill and the rust as *Coleosporium sonchi-arvensis* (Pers.) Lev. As this European rust had not been previously reported as occurring in America, I visited the locality in June, 1913, to see if it was permanently established. The host of the Peridermium of this species in Europe is *Pinus sylvestris* L. This pine I found about the grounds as an ornamental and shade tree and also in an old nursery plantation. All of these trees bore the peridermial stage of the rust, many of them in profusion. A single tree of *Pinus strobus* L. was found upon the premises and upon this no Peridermium was seen. About half a mile distant, in a seed bed of *Pinus banksiana* Lamb., a single leaf was found bearing a Peridermium, but it has not been determined as yet that it is of this species. As the Jack pine, like the Scotch pine is twin leaved, it may be that the rust would attack it also and the native red pine as well.

The mode of introduction and establishment of this rust seems to have been as follows: Five or six years ago an importation of Norway spruce was made and the trees were unpacked along side of the Scotch pine plantation. Doubtless in or with the packing of these young spruce were rusty leaves or fragments of leaves of sow thistle. If so, the teliospores doubtless germinated in the spring and the *Pinus sylvestris* was at hand to bear the Peridermium. Not far away was a wood pile which had gradually migrated toward the house leaving in its wake a soil composed largely of well rotted chips. Here was a flourishing bed of sow thistle which received the peridermial spores and made possible the completion of the life cycle of the rust. A few rods distant was a house surrounded by

Scotch pines and with sow thistles in the garden so that another station was added to the initial one. As the Peridermium of this rust is annual it does no damage except the destruction of a certain amount of leaf tissue, and the disease can be readily eradicated by destroying all Sonchus plants in the vicinity. However, the introduction and the establishment of this foreign rust shows clearly that all packing and refuse that accompany imported plants should be thoroughly destroyed, as even small fragments of leaves may introduce disease-producing organisms.

UNIVERSITY OF WISCONSIN HERBARIUM

NOTES ON CRONARTIUM COMPTONIAE, II[1]

PERLEY SPAULDING

In a previous note the writer[2] gave some data concerning the eastern pitch pine blister rust caused by the fungus *Cronartium comptoniae*. Since that time it has become evident that this fungus is of considerable economic importance, a fact, which was not realized when the writer's investigations were begun. Its supposed harmlessness was due to the fact that the native host pines, *Pinus rigida*, *P. virginiana*, and *P. divaricata* (which is probably also a host), are ordinarily of little value as timber trees, and while it was known that a number of young trees died from its effects they were considered to be of practically no value. Reports received by the writer, and personal observations, have shown that it causes a serious nursery disease upon several species of the pitch pines. *P. ponderosa* seems to be especially susceptible. Specimens on this host were received from two localities in Massachusetts, and it was noted by the writer in one Connecticut locality. In the latter, approximately 10 per cent of the total stand (about five years of age) bore fruiting bodies of this fungus. The fungus from the two Massachusetts localities was successfully inoculated onto *Comptonia asplenifolia*, by the writer in one case and by Dr. G. G. Hedgcock in the other, confirming previous transfers between these hosts by Clinton[3] and the writer.[4] There is little doubt that this fungus will be a serious enemy of *Pinus ponderosa* in the eastern states should that pine ever be grown in any quantity here in seed beds. *P. sylvestris* was reported by Clinton[5] in 1908 as a host for this fungus and successful inoculations were made by him upon leaves of *Comptonia asplenifolia*. In 1912, it was received by the writer from a Massachusetts locality and successful inoculations were made upon *C. asplenifolia*.[6] This season it was received from another Massachusetts locality, and successfully cross inoculated. No case has yet been seen where any considerable number of trees of *Pinus sylvestris* was affected, but the above cases show there is some danger to this host species under conditions favorable

[1] Published by permission of the Secretary of Agriculture.

[2] Spaulding, Perley, Notes on Cronartium comptoniae. Phytopathology. **1**: 62 1913.

[3] Clinton, G. P., Report of the botanist. Conn. Agr. Expt. Sta. Rept., **1907–1908**: 380–383. 1908.

[4] Spaulding, Perley, loc. cit.

[5] Clinton, G. P., loc. cit.

[6] Spaulding, Perley, loc. cit.

to the fungus. It should be remarked, however, that the evidence indicates that the heavy infections of all the pines take place while the trees are three years old or younger. This is shown by the position of the fungus at or below the first whorl of branches in most cases, and by the fact that careful search has thus far failed to reveal any infection in a large lot of healthy *P. sylvestris* trees which have been set out for a number of years where the fungus is present in abundance upon both *Comptonia asplenifolia* and *Pinus rigida*. It is not uncommon to find trees which have the rust located higher in the main stem or out on the branches, but such cases make but a small percentage of the total number of affected trees. At least, this is the writer's experience to date in observations made during the past five years, throughout the region north and east of Washington, D. C. This fungus has appeared also as a threatening enemy of young trees of two other pitch pines: i.e., *Pinus taeda* and *P. echinata*. The former is being successfully grown in New Jersey considerably north of its natural range, but has been found to be attacked in the nursery by *Cronartium comptoniae*. Specimens of diseased *Pinus taeda* were received by the writer and successful inoculations made by him in the greenhouse with the spores upon *Comptonia asplenifolia*. A specimen of young *Pinus echinata* affected by this fungus was received in 1908 from Biltmore, North Carolina, with the information that it was common on seedlings of this host which were being raised there for forestry planting. Thus we see that within a few years this fungus has been found affecting four different species of the more valuable timber pines in nurseries. It is also known to occur upon *Pinus austriaca* and *P. virginiana* occasionally, and specimens on these hosts are in the writer's hands, the former from a Massachusetts locality and the latter from a Maryland locality. Spores from *P. austriaca* have been successfully inoculated onto *Comptonia asplenifolia* by the writer.

Pinus rigida seems to be the favorite native host pine for this fungus, however. In a previous paper[7] the writer stated that a mortality for a single year from this disease of over 5 per cent of the diseased trees was observed in a lot of natural reproduction of this species. The trees were mostly less than 10 feet in height, but some were taller than this. This season a recount of the diseased trees of this area which bore fruiting bodies of the fungus was made Someone had removed a number of the metal tags placed upon the diseased trees last year, but sixty-six out of the one-hundred and forty-seven were found still bearing the tags and sixty-three of those from which the tags had been removed were retagged. The remainder were scattered away from the main body and were not hunted up, it being thought best to work with a compact body of trees. Of the sixty-

[7] Spaulding, Perley, loc. cit.

six trees still bearing tags, and which last year bore fruiting bodies, sixty-three also bore them this year. The three which had no fruiting bodies this year were covered toward the base with pitch which had exuded through the crevices in the bark. This seems to be quite characteristic for trees of this species when dying from the effects of this disease. In the area occupied by the one hundred and twenty-nine diseased trees which were counted, a total of ten trees was found recently dead. These, in the writer's judgment bore evidences of dying from the attacks of this fungus. Indeed, four of them bore tags placed on them last year, showing that they bore fruiting bodies then. The writer is quite sure the remainder also had tags, but that they had been removed. In these counts no tree is counted as dead until the leaves have all died. Several were noted which will die shortly, but their leaves are still green and they were not counted. The above figures show a mortality for 1913 of 7.8 per cent and one of nearly 13 per cent of the total number of diseased trees for the two years that records have been kept. Such a loss as this with a valuable species of pine would ordinarily be considered serious[8] especially where this rate of loss will apparently be continued for a considerable number of years. Ordinarily trees of *Pinus rigida* do not show this disease or the fruiting bodies of the fungus after they attain a diameter of about 4 inches, which occurs at about the age of twenty years. In fact it is a rarity to find a tree of this size bearing fruiting bodies of the fungus. A single tree was found this season, however, which was fully six inches in diameter and which had fruiting bodies on the thin bark of a partially healed wound, and none anywhere else, although there was some evidence of the disease having been present lower down on the stem and of its having extended up to the wound. Apparently the bark becomes so thick on older trees that the fungus cannot push forth its fruiting bodies, as the fruiting bodies on older trees are always located in the crevices where the bark is thinnest. It is believed that most of the diseased trees die before they reach this stage, but there are apparently a few which continue to live with the fungus present. It seems entirely possible for occasional diseased trees to reach such an age that the bark is too heavy for the fungus to push forth its fruiting bodies.

The numerous above mentioned specimens of this fungus from Massachusetts do not indicate that there is any more of this disease there than in other states, but that more material has been available for study from Massachusetts.

U. S. DEPARTMENT OF AGRICULTURE
WASHINGTON, D. C.

[8] Clinton G. P., Report of the botanist, 1909 and 1910. Conn. Agr. Expt. Sta. Rept. **1909–1910**: 733. 1911.

PHYTOPATHOLOGICAL NOTES

Another host for Rhodochytrium. Since the discovery several years ago of *Rhodochytrium spilanthidis* Lagerh. on the ragweed in the United states, two notes have appeared relative to its distribution. The first of these by Atkinson[1] records its collection in fourteen localities in North Carolina, and the second by Hall,[2] in twelve places in South Carolina, two in Alabama and one in Maryland. The latter investigator is of the opinion that it may be found in Virginia and Georgia, thus connecting Alabama, the Carolinas and Maryland. It might be of interest to add that, during the past summer, it has been collected by Prof. J. S. Caldwell in the mountains of Eastern Tennessee and by the writer in two additional localities in Alabama, Montgomery and Fort Payne.

While making the collections near Montgomery, this algal parasite was found growing upon the leaves and stems of the giant ragweed, *Ambrosia trifida* L., which occurred together with the common ragweed *A. artemisiifolia* L. It has previously been reported only on three hosts, *Spilanthes* sp. in Ecuador, *Asclepias pumila* in Kansas, and on the common ragweed as noted above. Because of the close relationship of the two species of Ambrosia and the fact that parasitized plants of both species were growing side by side, there can be no doubt that the form on *A. trifida* is the same as the one on *A. artemisiifolia.* Material from this collection has been sent to Prof. G. F. Atkinson, Cornell University, and to Dr. R. F. Griggs, Ohio State University.

Since the giant ragweed is so widely distributed it seems highly probable that Rhodochytrium may be found upon it coextensive with this parasite upon the common ragweed. This note is published merely to direct the attention of collectors to another host while studying the distribution of this remarkable parasite.

FREDERICK A. WOLF

Note on Plowrightia morbosa. *Plowrightia morbosa* is universal in Iowa on all sorts of wild plums. I have never noticed it on *Prunus virginiana* or *P. pennsylvanica*; but about Lake Okoboji in the northwest corner of the state, black-knot occurs not only on all the wild plums, sometimes to the

[1] Science **28**: 691–692. 1908.
[2] Science **38**: 364. 1913.

extermination of a grove, but proceeds further and assails the thickets of June-berry, *Amelanchier canadensis*, and does immense damage.

On the wild plum the black-knot is frequently accompanied by *Fomes igniarius*, a saprophyte, no doubt, but in this instance as in many others that might be cited, I fancy the fungus is not always careful to wait the preparation of its banquet by secondary causes or agencies more remote. Instead, it sometimes becomes "particeps criminis," hastens by its presence, if in no other way, the fatal issue in the nobler plant, and kills the patient by the mere rattle of the undertaker's wagon. The subject of facultative parasitism today affords a wide field for investigation.

T. H. MACBRIDE

The International Institute of Agriculture in its fourth session at Rome, May 5 to 12, 1913, considered a proposal for an international agreement for the control of plant diseases, and unanimously adopted the following resolutions

"1. The general assembly recommends that the governments adhering to the Institute organize, if they have not already, a government service of phytopathology.

"2. The general assembly, recognizing the need of an international agreement on the means of controlling plant diseases, deems it essential that an international commission of experts be convened and expresses the wish that the French government continue the initiative it took in this matter by bringing about the holding of such an international commission as soon as possible and not later than May, 1914.

"3. The general assembly is of opinion that on the occasion of each session of the general assembly of the International Institute of Agriculture experts of the adhering governments should meet in a special commission to come to a mutual understanding on their common researches and studies on plant diseases.

"4. The general assembly calls on the adhering governments to initiate the study of the several questions to be brought before the international commission of phytopathology on the basis of data to be supplied by the International Institute of Agriculture."

A brief report of this meeting of the International Institute of Agriculture at Rome is available in Senate document 196, 63d Congress.

The French government has renewed its official invitation to the United States to participate in an International Conference of Phytopathology to be held at Rome, February 24, 1914. Under the existing law it will be necessary to secure authority from Congress to accept this invitation.

Personals. Mr. Fred D. Fromme, graduate of the South Dakota State College, and Mr. H. C. Travelbee, graduate of Purdue University, have become assistants in the botanical department of the Indiana Experiment Station, filling positions formerly occupied by Dr. F. D. Kern and Mr. J. B. Demaree, who have gone to Pennsylvania State College. Their chief work will be in connection with the rust problems under investigation by the department.

Dr. F. L. Stevens, recently Dean of the College of Agriculture, Mayaguez, Porto Rico, has been appointed to the newly established professorship of plant pathology in the department of botany of the University of Illinois. He will transfer his relations to Illinois, February 1.

Dr. Bascombe B. Higgins, recently a graduate student in Cornell, has been appointed botanist and plant pathologist in the Georgia Experiment Station.

Dr. W. Ralph Jones, recently scientific assistant in the office of fruit disease investigations in the Bureau of Plant Industry, has been appointed professor of biology in Emory College, Oxford, Ga. He is succeeded by Raymond B. Wilcox, lately a graduate student in plant pathology in the University of Wisconsin.

Dean H. Rose, sometime assistant in botany in the Kansas Agricultural College, and more recently a graduate student in the University of Chicago, has been appointed pathologist in the Missouri State Fruit Experiment Station at Mountain Grove, Mo.

Dr. C. E. Lewis has resigned his position as associate in plant pathology in the Maine Experiment Station, to enter private business.

John H. Parker, recently assistant in plant pathology in the College of Agriculture of the University of Minnesota, has been appointed scientific assistant in the office of cereal investigations of the Bureau of Plant Industry.

Geo. F. Miles has resigned his position as pathologist in the office of cotton and truck disease and sugar plant investigations in the Bureau of Plant Industry, and has assumed charge of the truck growing department of the Potter Palmer Company, Sarasota, Fla.

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LIST OF PAST AND PRESENT OFFICERS OF THE SOCIETY

1909

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1912

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1913

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CONSTITUTION OF THE AMERICAN PHYTOPATHOLOGICAL SOCIETY ADOPTED AT MINNEAPOLIS MEETING, DECEMBER 30, 1910

ARTICLE I

This Society shall be known as The American Phytopathological Society.

ARTICLE II

MEMBERSHIP

SEC. 1. The Society shall consist of members, and may include life-members and patrons.

SEC. 2. The charter membership of this Society shall consist of the one hundred and thirty persons who accepted the invitation of the Organization Committee of October 25, 1909, to form the Society.

ARTICLE III

QUALIFICATIONS FOR MEMBERSHIP AND DUES

SEC. 1. All persons interested in the study of phytopathology, including the practical control of plant diseases, shall be eligible to membership.

SEC. 2. Each member shall pay annually such dues as the Society shall determine.

SEC. 3. Any member may become a life-member upon the payment of fifty dollars, and any person may become a patron upon the payment of two hundred dollars, and upon election shall have all the privileges of membership.

ARTICLE IV

ELECTION OF MEMBERS

Members may be elected at any regular meeting of the Society or by the Council during the interim. Applications for membership must be endorsed by at least one member of the Society.

ARTICLE V

OFFICERS

The officers of the Society shall consist of a President, Vice-President, and Secretary-Treasurer. Their duties shall be those usually performed by such officers. The President and Vice-President shall serve for one year and the Secretary-Treasurer for three years, or until their successors are elected, and the Council shall fill any vacancies occurring in the interim between elections.

The Council shall consist of the President, Vice-President, Secretary-Treasurer, the retiring President, and the Chairman of the Board of Editors of the Journal of the Society, with two members elected, one each year, who shall serve for a term of two years. All action of the Council or Officers must be authorized or approved by the Society.

ARTICLE VI

ELECTION OF OFFICERS

Officers shall be elected by a majority vote of the members present at the regular annual meeting.

ARTICLE VII

EDITORS AND COMMITTEES

The Editors of the official organ of the Society shall be selected by the Council subject to the approval of the Society. Temporary or standing committees may be appointed at the discretion of the Society.

ARTICLE VIII

MEETING

An annual meeting shall be held at such time and place each year as the Council may select, and additional meetings, including special or local meetings, for the presentation of papers, may be arranged by the Council at its discretion.

ARTICLE IX

AMENDMENTS

This Constitution may be amended at any annual meeting by a three-fourths majority of all the members voting, notice of the proposed amendment having been sent to all the members at least one month previous to the meeting.

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